NEW MAMMALS IN THE 21st CENTURY?

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Abstract

After 50 years in which only one new large mammal had been found worldwide, three new ungulates were found in the same region of Vietnam within 4 years. The context of the finds is discussed in relation to the continuing finds of other mammals and birds. This paper draws conclusions about the types of places that may still conceal undiscovered mammals and predicts where future finds may be made into the next century.

Key words: Bovidae, Cervidae, Laos, mammals, *Megamuntiacus*, *Muntiacus*, muntjac, *Pseudoryx*, Saola, Vietnam.

New Mammal Finds among Scars of War

Out of the several million species of animals known to inhabit this planet, only a small number are mammals (just over 4600) and birds (11,000); yet these are the creatures the general public best know, like, and show most concern for. That there remain over 10 million microscopic insects to discover and name may fascinate biologists, but this does not make the newspaper headlines. Taxonomists see the job of describing the varied life forms of our planet as incomplete. The general public see it as a job nearly finished with just a few last hidden creatures still to be found.

Ever since Linnaeus began describing and counting the species with which Man shares the Earth, the number of known species has continued to grow. For some groups, the species discovery curve continues to rise ever steeper, but for the warm-blooded vertebrates, especially the large mammals, the curve is leveling off (Medellín & Soberón, 1999), and we can hazard some guesses as to how many more species there are still to find. Medellín and Soberón (1998) estimated another 247 mammals, mostly small, will be discovered between 1992 and 2032.

During the first three decades of this century, only a handful of new large mammals were discovered. The finding of okapi, *Okapia johnstoni*, in 1901 in the forests of Congo created enormous popular interest and speculation that this was the last great new mammal. But other new African finds were quickly made: giant forest hog, *Hylochoerus meinertzhageni*, in 1904, and Mountain Nyala, *Tragelaphus buxtoni*, in 1910, before the African vein started to dry up. In 1937, Urbain described the Kouprey, *Novibos sauveli*, a large ox of Cambodia, actually found in a zoo in Paris. During the next 50 years, only one new large mammal was found. The Chaco Peccary, *Catagonus wagneri*, already known and named from fossils, was found to be still extant (Wetzel et al., 1975). A few new species were added by taxonomists splitting known forms: African colobine monkeys, Sulawesi macaques. Some zoologists believed the large mammals were, by and large, all in the museum and cataloged.

Discoveries of new birds have been equally scarce. Ninety-eight percent of all 1135 Palearctic birds were described between 1758 and 1900. Only seven new Palearctic birds have been described since 1920, with five of these being in the less-explored regions of China (Roselaar, 1994). Moreover, three of the seven finds lay for years unrecognized in museum collections before being recognized as new: pink-rumped rosefinch, *Carpodacus eos*, Vaurie's nightjar, *Caprimulgus centralasicus*, and Sillem's mountain finch, *Leucoslicte sillemi*. The last had been collected 62 years before being recognized as new in the Museum of Amsterdam (Roselaar, 1994).

In 1992, a completely new, large mammal was found in the North Annam mountains in the Vu Quang Nature Reserve of Vietnam: the Saola or Vu Quang ox. Assigned to its own genus, *Pseudoryx*, DNA showed the ox was a primitive member of the cow and goat family Bovidae (Dung et al., 1993). Two sets of the unique horns were initially found hanging as a hunter's trophies in a Vietnamese village. Subsequent morphological and genetic studies have shown the animal is so unlike anything else that it should be regarded as a new subfamily. A great amount of media interest was devoted to the find, but it took two years before anyone actually saw the animal alive, when two young animals were caught by farmers and brought to Hanoi.

The find was exciting for several reasons. It caused a major revision of the taxonomy of the fam-

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ily Bovidae. It helped highlight the conservation status of the neglected Annam Mountains Region. But most of all, it made people realize we really do not know all our large mammals, and it is still worth looking for more.

Subsequent surveys in Vu Quang turned up a second new ungulate, the giant muntjac, *Megamuntiacus vuquangensis* (Tuoc et al., 1994). The finds were made in the same village as was found the type specimen of the Saola. This muntjac species was initially given a new genus name because it did not match the existing genus description for *Muntiacus* (Groves & Grubb, 1990). Further DNA studies have shown the new genus may be insufficiently distinct to warrant its own genus (Giao et al., 1998). There is some argument (Schaller & Vrba, 1996; Groves & Dawson, in press) as to whether *Muntiacus* should be redefined to accommodate the giant muntjac. This cervid mammal differs from the other seven known muntjacs by its larger size, short pedicles, and much larger, more spreading antlers.

Both Saola and giant muntjac were also found in Laos, with wider searches in the Annamite Mountains revealing a new pygmy muntjac, *Muntiacus truongsonensis* (Giao et al., 1998). In Laos, the Roosevelt's muntjac (previously known from only one specimen) was rediscovered together with a bearded pig, *Sus bucculentus* (previously known from only one lost specimen in Shanghai Museum) (Schaller & Vbra, 1996). A new striped rabbit was also found in Laos (formerly thought to be a Sumatran endemic genus) and has now also been found in Vu Quang and Pumat Reserves in Vietnam, and still awaits scientific description. Another small muntjac has also been found in the central Annam Mountains of Vietnam, awaiting analysis and description (Hulse, pers. comm.).

Vu Quang, itself in a remote evergreen part of the North Annam Mountains on the border between Vietnam and Laos, continues to reveal novelties. Two new species of fish have just been described there (WWF, 1996).

North Annam was already recognized as a small pocket of local endemism with such local specialities as Owston's palm civet, *Chrotogale owstoni*, Hatinh leaf monkey, *Semnopithecus (francoisi) hatinhensis*, Vietnamese pheasant, *Lophura hatinhensis*, and sooty babbler, *Stachyris herberti*. These new finds of undescribed mammals add significantly to the biological and conservation importance of this region.

These exciting new discoveries in Vietnam and Laos seemed to stimulate a new wave of search and discovery around the world. A new antelope, *Pseudonovibos spiralis*, was described from Cambodia on the basis of several sets of unique spiraling horns (Peter & Feiler, 1994). But the failure of efforts to find the animal alive suggest we may be too late to see or save this species. A new tree kangaroo (the bondegezou) was discovered in the Jayawijaya Mountains of Indonesian New Guinea. No less than seven new marmosets (the latest being *Callithrix mauesi* and *C. nigriceps*) were added to the mammals list in Brazil. Two new bushbabies, *Galaoides rondoensis* and *G. udzungwensis* (Kingdon, 1997), have been described from Tanzania. A new horse was reported in the popular press from Xinjiang, China.

Are we on a new wave of discovery? In fact, the discovery of new mammals has been rather steady throughout the century. More than a hundred new mammals have been described without attracting much public attention (Wilson & Reeder, 1994). These have been largely bats, rodents, and insectivores, or cases of splitting up previously recognized taxa such as the Sulawesi macaques and Sulawesi tarsiers.

Where Will Future Finds Be Made?

The Annam Mountains of Vietnam and Laos do seem to be a rich, and still not fully explored, source of diversity. It is one of the world's overlooked "biodiversity hotspots." The spectacular mammalian finds are largely due to a time warp in an area where zoological exploration had been held up for 50 years due to constant warfare and political trouble. But these finds do give us clues about where to find yet more new species.

Despite being in one of the most populated regions of the earth and a region heavily devastated by both chemical and physical bombardment during the Vietnam War, the North Annam Mountains are rugged, difficult to access, unattractive for agriculture, and ecologically isolated from much drier surrounding lowland forests. Highland peaks are small and separate, resembling a small archipelago of evergreen montane islands. The region is part of an evergreen tropical continental system that has enjoyed climatic stability for thousands of years and where climatic oscillations of the Pleistocene could be easily accommodated by species by making minor vertical movement in the steep terrain (Giao et al., 1998). These are conditions ideal for the creation of local endemic species as well as for the survival of primitive and relict forms. The region is both a classic Pleistocene refuge and a source of new vertebrate radiation.

The following key characters can be identified as

indicators of the likelihood of a given geographic area still hiding undiscovered forms:

(1) area of long geological stability;
(2) area of tropical richness;
(3) region of long-term humid conditions (Pleistocene refugia);
(4) remote and poorly explored;
(5) semi-isolated and archipelago-like habitat islands;
(6) relatively small size of habitat islands;
(7) high levels of endemism in other groups.

North Annam fulfills all these criteria admirably.

Most of the localized endemic vertebrates of Asia show montane or insular distributions: Western Ghats, southeast China mountains, central China mountains, Mt. Kerinci (Sumatra), Mt. Kinabalu (Borneo), Taiwan, Mt. Victoria (Burma), West Javan mountains, Sulawesi, the Philippines, and the Mollucan islands. Contrast these with the generalized Asian large mammal fauna of elephant (*Elephas maximus*), tiger (*Panthera tigris*), leopard (*Panthera pardus*), gaur (*Bos gaurus*), wild boar (*Sus scrofa*), sambar deer (*Cervus unicolor*), and red muntjac (*Muntiacus muntjak*), which occur broadly from northwest India to Borneo, and through a huge range of altitudinal and rainfall differences. These latter large mammals probably constitute a fauna that has followed Man south and east through Asia, benefiting from human opening and burning of the forests and displacing the original, more evergreen-forest fauna. Glimpses of this richer fauna can be seen in the fossil record of the Siwaliks of north India.

In Africa, one also finds that endemism and species richness are concentrated around relict evergreen mountains and Pleistocene refugia: west African rainforest, Mt. Cameroon, eastern Rift forests, and east Tanzanian forests and mountains. In contrast, the huge forests of the Congo basin and the huge savanna plains of east and southern Africa have little endemism.

The new mammals of the 21st century will be found in the still unexplored regions that meet the criteria mentioned above of isolation, tending to be tropical and evergreen systems, and lying within the regions of high species diversity or endemism. Such unexplored areas remain in northeast India, Burma, Laos, southeast Tibet, northwest Yunnan, south Philippines, New Guinea, peripheral mountains of the Amazon Basin, isolated mountains of Central America, as well as smaller neotropical drainage systems.

In addition, there are many new descriptions to be made among lesser explored taxa and the less spectacular and more difficult small mammals. Birds are much better known than mammals because they are mostly diurnal, can mostly be recognized in the wild at long range or by vocalization, and because the world is swarming with rather professional amateur birdwatchers. In contrast, most small mammals are nocturnal, live in concealed spots, and are very difficult to identify. And sometimes they smell and bite!

However, the scientist now has several important new tools to help predict where species are likely to be and also to record, catch, and distinguish species. Satellite imagery allows habitats to be more easily recognized and mapped, which enables potential species distributions to be determined. Automatic cameras allow shy secretive animals to be recorded. Tape recorders and sonographs allow vocalizations to be used for identification and to distinguish between forms. GPS (geographical positioning systems) allow much greater accuracy in locality information, which enables a tighter definition of species habitat requirements. IT (information technology) allows much faster comparison of material by scientists. Air travel and better communications allow biologists access to areas previously only accessible by major expedition. DNA analysis provides a whole new high-resolution technique for discriminating relationships between populations and species.

For instance, the common Grant's gazelle (*Gazella granti*) of East Africa resolves into at least three different species on the basis of DNA differences (P. Arctander, pers. comm.). The whole concept of what is a species is raised once again. Some species seem morphologically very distinct, but DNA reveals they are not. Other species are morphologically inseparable but found to be very different genetically. Efforts to define objective morphological criteria for defining species start to break down. Whether one adopts a biological species concept or a phylogenetic species concept, it is expected that good species in nature maintain discrete breeding. However, more and more evidence of cross-breeding between wild species is discovered. Most organisms accept alternatives if the perfect mate is not available, and breeding among closely related species does result in hybridization. All members of the family Cervidae can be made to hybridize with all other members in captivity (Arctander, pers. comm.). However, even wide, stable hybrid zones can be accepted without invalidating species status if hybrids remain at a disadvantage in the mating game. With birds, for instance, it can usually be demonstrated by playback experiments that there is a stronger response

to the true species call than to either the call of the second species or a hybrid. As more of these species come under DNA scrutiny we will be able to move closer to a phylogenetic species concept, and many forms now placed conservatively within one species will split.

The question of where species begin and end becomes more complicated when legal aspects become involved for protection, control of trade, and ownership of genetically modified organisms. The least recognized unit is ultimately the individual. Species evolve from one into another and split gradually from one to two through isolation. There is no objective cut-off point. We must accept that our criteria are rather subjective and not consistent across the board. We must redefine satisfactory new ways to label the individual. The question of "How many species are there?" returns again to the age-old taxonomists' puzzle of "What is a species?"

The world loses species and genetic variety at an unprecedented pace, but thanks to taxonomists, our lists grow longer and longer and we should be on guard lest a sense of loss is dulled by new discovery. It is important that taxonomists become aligned to the conservation movement, where their skills are sorely needed. Monitoring biodiversity is as important as describing biodiversity.

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